

ON THE NEARBY BINARY BROWN DWARF WISE J104915.57-531906.1 (LUHMAN 16)

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ABSTRACT

I report some observations and calculations related to the new nearby brown dwarf at $d = 2$ pc discovered by Luhman (2013, ApJ Letters, in press; arXiv:1303.2401). I report archival astrometry and photometry of the new object from IRAS (epoch 1983.5; IRAS Z10473-5303), AKARI (epoch 2007.0; AKARI J1049166-531907), and the Guide Star Catalog (epoch 1995.304; GSC2.2 S11132026703, GSC2.3 S4BM006703). A SuperCOSMOS scan of a plate taken with the ESO Schmidt Telescope (epoch 1984.169) shows the source as elongated ($PA = 138^\circ$). Membership of the binary to any of the known nearby young groups within 100 pc appears unlikely based on the available astrometry and photometry. Based on the proper motion and parallax, a Monte Carlo simulation of thin disk/thick disk/halo stars is suggestive that the binary is, unsurprisingly, most likely a thin disk star ($\sim 96\%$), with a $\sim 4\%$ chance that it is a thick disk (and negligible chance that it is a halo star). I propose that this important new nearby substellar binary be called by either its provisional Washington Double Star catalog identifier (“Luhman 16”), or perhaps “Luhman-WISE 1”, either of which is easier to remember than the WISE identifier.

Subject headings:

1. INTRODUCTION

Luhman (2013) recently discovered a new system (WISE J104915.57-531906.1) which appears to be the nearest “star”¹ to the Sun discovered in nearly a century (Proxima Centauri was discovered in 1915, and the distance to Barnard’s star was constrained by the mid-1910s as well). This remarkable discovery was made possible using astrometry and photometry from the NASA WISE mission (Wright et al. 2010).

As this system will become an important benchmark object for the study of substellar L dwarfs, and no doubt attract follow up investigations, I decided to present my notes on this object in a timely manner. In §2, I discuss new detections of the object in the AKARI, IRAS, and GSC catalogs (epochs between 1983 and 2007), and a SuperCOSMOS detection of the object on an ESO Schmidt Telescope plate (epoch 1984). In §3 I discuss the kinematics of the star, and in §4 I discuss the nomenclature of this interesting new system.

2. APPEARANCE IN OTHER CATALOGS

Luhman (2013) found optical/IR counterparts to WISE J104915.57-531906.1 in various astrometric/photometric catalogs, and listed the following aliases: 2MASS J10491891-5319100 and DENIS J104919.0-531910. The object is fairly bright in 2MASS ($J = 10.73$, $H = 9.56$, $K_s = 8.84$), and conspicuous in the WISE All-Sky Data Release catalog ($[W1] < 8$, $[W4] < 6!$).

Based on the 2MASS position (epoch 1999.375) and the proper motion in Luhman (2013; $\mu_{\alpha*} = -2759 \pm 6$ mas yr⁻¹, $\mu_\delta = 354 \pm 6$ mas yr⁻¹), I estimate the

ICRS/J2000 position for epoch J2000.0 to be approximately 10:49:18.723 -53:19:09.86 (α , $\delta = 162.3280125$, -53.3194046). I have not yet included the parallactic motion, so this position for epoch 2000.0 is currently accurate to only $\sim 1''$. In Table 1, I list predicted positions of the binary at various useful past and future epochs (accuracy $\sim 1''$). The coordinates are of sufficient accuracy to search for pre-WISE astrometry in various astronomical catalogs.

2.1. AKARI

I tested whether the object may be the counterpart to AKARI/IRC point source J1049166-531907, which lies $9.37''$ away from the WISE coordinates (epoch ~ 2010). The mean epoch for the AKARI point source position is not listed in the AKARI/IRC All-Sky Survey Point Source Catalog Version 1.0² (Ishihara et al. 2010), however the AKARI cryogenic mission ran between UT 8 May 2006 (2006.351) and 26 August 2007 (2007.652), hence I assume a mean epoch for the AKARI position of 2007.0. For epoch 2007.0, Luhman’s binary brown dwarf would have been near ICRS position 10:49:16.57 -53:19:07. This position is within $1''$ of the position of AKARI J1049166-531907 (epoch 2007.0), and this AKARI/IRC source is the only one within 4.7 arcminutes. The AKARI point source has a positional uncertainty ellipse of $0''.45 \times 0''.21$ ($PA = 89.66$ deg). Hence, the positional agreement between the AKARI point source position and the predicted 2007.0 position of the new binary is excellent. The AKARI/IRC All-Sky Survey detected this source in 9 scans, and quotes a $9 \mu\text{m}$ flux in the AKARI/9SW band of $1.558\text{e-}1 \pm 9.33\text{e-}03$ Jy. No $18 \mu\text{m}$ flux is listed, and the object is not listed as a source in the AKARI/FIS (Far-infrared 50-180 μm) survey. Adopting the zero-magnitude flux density of 56.26 Jy from Ishihara et al. (2010), this flux

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¹ I use the term “star” loosely, as it is clear that the components of the binary are clearly substellar.

² <http://cdsarc.u-strasbg.fr/viz-bin/Cat?II/297>

TABLE 1
PREDICTED POSITIONS FOR WISE J104915.57-531906.1

(1) Epoch	(2) α_{ICRS}	(3) δ_{ICRS}	(4) Notes
2014	10:49:14.41	-53:19:05	
2013	10:49:14.72	-53:19:05	
2010	10:49:15.64	-53:19:06	WISE epoch
2007.0	10:49:16.57	-53:19:07	AKARI epoch
2005	10:49:17.18	-53:19:08	
2000	10:49:18.72	-53:19:10	
1995.3	10:49:20.17	-53:19:12	GSC epoch
1995	10:49:20.26	-53:19:12	
1990	10:49:21.80	-53:19:13	
1984.169	10:49:23.60	-53:19:15	ESO Schmidt epoch
1983.5	10:49:23.80	-53:19:16	IRAS epoch
1980	10:49:24.88	-53:19:17	
1970	10:49:27.96	-53:19:20	
1960	10:49:31.04	-53:19:24	
1950	10:49:34.12	-53:19:28	
1900	10:49:49.51	-53:19:45	

density translates to magnitude $[9] = 6.39 \pm 0.07$ mag. This is similar to the magnitude quoted in the WISE Channel 3 ($11.6\mu\text{m}$ band) – $[W3] = 6.200 \pm 0.015$ – further securing the cross-identification.

2.2. IRAS

It is possible that Luhman’s binary combined with another WISE source (WISE J104924.57-531910.5) may together contribute infrared flux to the IRAS Faint Source Reject Catalog source IRAS Z10473-5303. The IRAS astrometry is for epoch J1983.5 and the IR source is at 10:49:24.6 -53:19:16, which is only $7.4''$ away from where Luhman’s object is predicted to be for that epoch (IRAS position uncertainties are an ellipse of $16''.6 \times 5''.2$ at $\text{PA} = 144^\circ$). This was a low S/N $12\mu\text{m}$ detection ($F_{12} = 0.1657$ Jy, $\pm 17.8\%$). For a Vega-like SED, this flux would translate to a $12\mu\text{m}$ magnitude of 5.53 ($\sim 20\%$ error). Luhman’s binary has $[W3] = 6.20$ mag (with a decidedly un-Vega-like SED), and WISE J104924.57-531910.5 has $W3 = 7.44$. These two objects would have been the brightest objects at $12\mu\text{m}$ within $1'$, and both likely contributed to the IR flux of IRAS Z10473-5303.

2.3. Guide Star Catalog

A plausible optical counterpart is detected in versions 2.2 and 2.3 of the Guide Star Catalog at epoch 1995.304. Based on the Luhman (2013) proper motion, I predict that the binary should appear at ICRS position 10:49:20.17 -53:19:12 at epoch 1995.304. The binary appears to correspond to the optical counterpart GSC2.2 S11132026703 (ICRS 10:49:20.156 -53:19:11.02, epoch 1995.304, $R = 18.16 \pm 0.44$, no B_J or V magnitude given) and GSC2.3 S4BM006703 (ICRS 10:49:20.156 -53:19:11.02, epoch 1995.304, $F = 18.16 \pm 0.44$, $j = 22.25 \pm 0.55$). The “ F ” photographic magnitude reported in GSC 2.3 was for IIIaF emulsion with OG590 R-band filter. The astrometry in the GSC 2.2 has errors of $0.419''$ in RA and $0.399''$ in Dec. The GSC2.2 and GSC 2.3 counterparts lie within $0''.5$ of the predicted position, however there is another unrelated

2MASS source $2.92''$ away which may be blending the photometry/astrometry.

2.4. SuperCOSMOS

As Luhman (2013) mentioned, the star is visible on “DSS IR” and “DSS red” plates taken in 1978 and 1992, respectively. I checked the SuperCOSMOS plate archive³ (Hambly et al. 2001) operated by the Institute for Astronomy (University of Edinburgh) to find their measured astrometry and magnitudes.

UKST red (1992): SuperCOSMOS lists the equinox J2000 position as ($\alpha, \delta = 162^\circ.3383111, -53^\circ.3202878 = 10:49:21.1947 -53:19:13.036$) on the UKST red plate OR 14804⁴ with IIIaF emulsion with the OG590 red filter. The epoch is listed as 1992.191, and a modified Julian Date of 48689.595616944 (which differs by a day from that quoted in Luhman 2013). SuperCOSMOS estimated a red magnitude of 18.578. This position differs from that measured directly by Luhman (2013) by only $0''.16$, well within the his quoted $0''.30$ positional uncertainty.

UKST IR (1978): SuperCOSMOS lists the equinox J2000 position as ($\alpha, \delta = 162^\circ.3562217, -53^\circ.3216400 = 10:49:25.4932 -53:19:17.904$) on the UKST infrared plate I 4176⁵ with IVN emulsion and RG715 filter. The epoch is listed as 1978.303, and a modified Julian Date of 43616.502665653 (which again differs from that listed by Luhman 2013 at the one-day level). SuperCOSMOS measured an IVN/RG715 magnitude of 15.289. This position differs from the measured directly by Luhman (2013) by $0''.55$ (where he estimated a position uncertainty of $0''.40$). As Luhman (2013) commented, on the 1978 plate the object appears to be slightly blended with a fainter star to the east.

³ <http://www-wfau.roe.ac.uk/sss/>

⁴ The housekeeping file for the scan can be found at: <http://www-wfau.roe.ac.uk/sss/cgi-bin/hk.cgi?survey=UKR&field=169>.

⁵ The housekeeping file for the scan can be found at: <http://www-wfau.roe.ac.uk/sss/cgi-bin/hk.cgi?survey=UKI&field=169>.

ESO red (1984): This is a new detection, and perhaps the most interesting one. SuperCOSMOS provides imagery for this region from the ESO Schmidt Telescope, for which a red (IIIaF emulsion, RG630 filter) image⁶ (ESO red plate R 5562) was taken epoch 1984.169 (MJD 45760.21756326). The quoted red magnitude is 18.501. Using the Luhman (2013) proper motion solution, I estimate that at this epoch, the object should appear near ICRS position 10:49:23.6 -53:19:15. An *elongated* point source appears near this position at ICRS position (α , δ = 162°.3487647, -53°.3211742 = 10:49:23.7035 -53:19:16.227). The elongated object on the plate appears in a rather empty region of sky where no other point sources appear in any of the images shown in Fig. 1 of Luhman (2013), hence the identification of the object on the ESO red plate with the new binary seems very secure. The SuperCOSMOS fit to the elongated object has major axis 35.77 μ m, minor axis 26.60 μ m with position angle PA = 138°. The position angle appears remarkably similar to that of the resolved pair in the GMOS image (epoch 2013) in Fig. 1 of Luhman (2013). The fact that the binary appears to have similar PA in 1984 and 2013 may be hinting that the original estimate for the orbital period by Luhman (2013) of ~ 30 yr may not be far from the actual period. Hambly et al. (2001) estimate the 1σ uncertainties in positions of stars on the ESO-R plates to be 0".133 in α and 0".173 in δ .

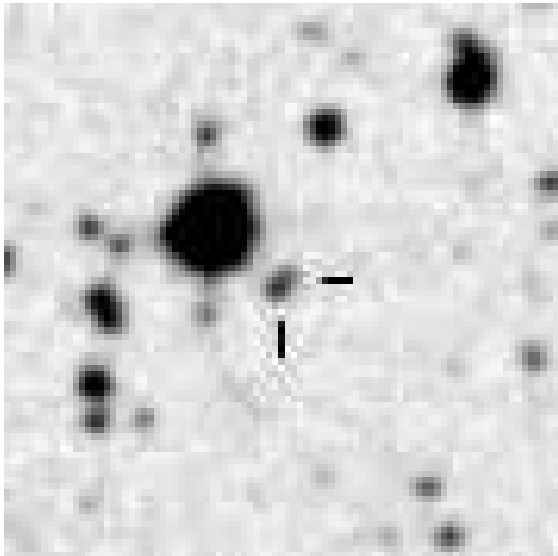


FIG. 1.— Image of WISE J104915.57-531906.1 in SuperCOSMOS scan of red (IIIaF emulsion, RG630 filter) image taken with ESO Schmidt Telescope (epoch 1984.169). Field of view is 1 arcminute. Nothing is visible at the position of the elongated source on images taken at other epochs (compare with Fig. 1 of Luhman 2013).

AAO/UKST H α Survey (1999):

2.5. Summary on New Astrometry

The new pre-WISE astrometry for WISE J104915.57-531906.1 is compiled in Table 2. Unfortunately the positional errors are sizeable compared to the WISE, 2MASS, and DENIS astrometry already presented in

Luhman (2013), and as astrometric solutions are usually weighted by the inverse variance of the positional errors, I have not bothered to recalculate an astrometric solution at this time.

3. KINEMATICS

3.1. Thin Disk? Thick Disk? Halo?

Even with just a proper motion and parallax, one can get a handle on which Galactic kinematic population the brown dwarf likely belongs to. The star's proper motion and parallax from Luhman (2013) are consistent with a tangential velocity $V_{tan} = 26.6 \pm 2.0$ km s⁻¹, which is typical for L dwarfs. Schmidt et al. (2010) showed that the distribution of tangential velocities for 748 spectroscopically identified L dwarfs had median $V_{tan} = 28$ km s⁻¹ with dispersion $\sigma_{V_{tan}} = 25$ km s⁻¹. The kinematic age of nearby L dwarfs in the solar neighborhood is ~ 3 -5 Gyr (Seifahrt et al. 2010), depending on how the age is calculated based on the velocity distribution. The metallicities and ages of field L dwarfs are largely unknown, so measurements of the velocity ellipsoid moments and their age evolution are not well constrained. If we assume that the solar neighborhood L dwarfs have velocity distributions and observed fractions of thin disk/thick disk/halo stars similar to that of local G dwarfs (adopted from Table 1 of Bensby et al. 2003), then we can generate synthetic UVW velocities for thin disk/thick disk/halo stars (and sampling within the parallax errors), and project the synthetic velocities at the synthetic distance to produce synthetic proper motions. Obviously this assumption can be criticized as one expects differences between the kinematics and age distribution of L dwarfs vs. G dwarfs, as the L dwarfs are expected to cool significantly as they age, however the differences between the kinematics of L and G dwarfs appear to be rather subtle (compare e.g. Bensby et al. (2003) with Seifahrt et al. (2010) and Schmidt et al. (2010)).

I generated 10^7 synthetic thin disk/thick disk/halo stars using the normalizations and velocity ellipsoids from Bensby et al. (2003). Among the 10^7 synthetic stars with proper motion vectors within 100 mas yr⁻¹ of the $\mu_{\alpha*}$, μ_{δ} pair estimated by Luhman (2013), the simulation produced 377 thin disk stars (96%), 16 thick disk stars (4%), and zero halo stars. For the synthetic thin disk stars, the predicted radial velocities had mean $v_R = 0$ km s⁻¹, with rms = 16 km s⁻¹. For the thick disk stars, the predicted radial velocities had mean $v_R = -18$ km s⁻¹, with rms = 31 km s⁻¹. Hence, the simulations predict that radial velocity of the system will likely not be far from zero.

The high likelihood of the membership of this star to the Galactic thin disk population (96%) is not unexpected. Luhman (2013) has already shown that the 2MASS and WISE infrared colors, and the 0.67-1.0 μ m spectrum, appear to rather typical for a late L dwarf in the solar neighborhood.

3.2. Could This Binary Belong to any Nearby Moving Groups?

⁶ The housekeeping file for this scan can be found at: <http://www-wfau.roe.ac.uk/sss/cgi-bin/hk.cgi?survey=ESOR&field=169>.

TABLE 2
ADDITIONAL ASTROMETRY FOR WISE J104915.57-531906.1

(1) Alias or Survey	(2) α_{ICRS}	(3) δ_{ICRS}	(4) σ_α	(5) σ_δ	(6) Epoch
AKARI/IRC J1049166-531907	10:49:16.61	-53:19:07.1	0".21	0".45	2007.0
...	162.31920	-53.31864
GSC2.3 S4BM006703	10:49:20.156	-53:19:11.02	0".419"	0".399"	1995.304
...	162.333984	-53.319728
IRAS Z10473-5303	10:49:24.6	-53:19:16	16".5	5".6	1983.5
ESO Schmidt (Red)	10:49:23.7035	-53:19:16.227	0".2	0".2	1984.169

NOTE. — The original AKARI/IRC error ellipse is $0''.45 \times 0''.21$ at $PA = 89^\circ.66$, and the original IRAS error ellipse is $16''.6 \times 5''.2$ at $PA = 144^\circ$. The original AKARI and GSC2.3 positions were quoted in decimal degrees, and the original IRAS and ESO Schmidt positions are provided in sexagesimal format.

At the time of writing, the proper motion and parallax for WISE J104915.57-531906 have been measured (Luhman 2013), but a radial velocity has not yet been measured (and given that the system is a binary with period $>$ decade, it is unlikely that a precise systemic radial velocity will be known for some time, however rough estimates should be forthcoming). With an accurate position and proper motion, one can test whether the binary is moving towards the convergent point of nearby moving groups. Such calculations have been useful in testing membership of young stars to nearby young moving groups (e.g. Mamajek et al. 2002; Mamajek 2005). Proper motions alone, however, are insufficient for assigning group memberships. Typically when radial velocities and trigonometric parallaxes are unavailable, color-magnitude criterion can be used (e.g. Hoogerwerf 2000). Since a trigonometric parallax has been measured (Luhman 2013), one can test whether the predicted cluster parallax (derived via the proper motion and predicted tangential velocity) and measured parallax agree. More sophisticated techniques have been developed within a Bayesian framework (Malo et al. 2013). However, I stick to the classic convergent point methodology here for simplicity, as one can grasp the degree of membership likelihood (or disagreement) by visually scanning the quantities μ_τ (the proper motion component perpendicular to the great circle between the star and the group convergent point; which should be statistically consistent with zero for an ideal group member), v_{pec} (the “peculiar” velocity; the tangential velocity of the μ_τ motion, which similarly should be statistically consistent with zero for an ideal member), and the predicted cluster parallax (which in this case can be compared to the measured trigonometric parallax). For a given group, if μ_τ and v_{pec} are significantly non-zero, and/or the predicted cluster parallax does not agree with the trigonometric parallax, then kinematic membership to a stellar group can be ruled out.

The author maintains an as-yet unpublished compendium of kinematic, position, age data for nearby young moving groups (clusters and associations)⁷. Some new kinematic values in the database were presented in a poster on the kinematics of young groups within 100 pc of the Sun using revised Hip-

parcos astrometry⁸ (Mamajek et al. 2010), and in Mamajek (2008), Luhman et al. (2009), Chen et al. (2011), Faherty et al. (2013), Barenfeld et al. (2013). Published kinematic data on nearby groups can also be found in papers by de Bruijne (1999); de Bruijne et al. (2001); Madsen et al. (2002); Zuckerman & Song (2004); Torres et al. (2008); Malo et al. (2013). The adopted convergent points, velocities, and 1D velocity dispersions for the known groups within 100 pc are compiled in Table 3.

Using the convergent point method (following Mamajek et al. 2002; Mamajek 2005, and references therein), and the convergent point solutions for the nearby young stellar groups, for each group I rotated the proper motion components $\mu_{\alpha*}$ and μ_δ for WISE J104915.57-531906 from Luhman (2013) into the proper motion component towards the convergent point (μ_v) and perpendicular to that component (μ_τ) (see Table 4). Using the μ_τ component and predicted cluster parallax, one can also calculate a “peculiar velocity”, which puts an estimate on the minimum velocity difference between the star’s velocity and that of the group. As seen in Table 4, none of the stellar groups provides a great combination of low μ_τ and v_{pec} along with cluster parallax that agrees with the observed trigonometric parallax. The most intriguing match is the ~ 40 Myr-old Argus group, which sports a somewhat low peculiar velocity (~ 3 km s⁻¹), and a predicted parallax ($\varpi = 510 \pm 25$ mas) that isn’t that far off (0.3σ) from the trigonometric parallax ($\varpi = 496 \pm 37$ mas). If the object belongs to the Argus group, it should have a radial velocity near $v_R \simeq 7.6$ km s⁻¹. However, such a young age (~ 40 Myr) seems unlikely given the near-IR colors of the binary. The observed $J - K_s$ color (1.89) is almost identical to the average color for L8/9 dwarfs (1.85, rms = 0.17 mag; Faherty et al. 2013), and the observed $W1 - W2$ color (0.56) is also almost identical to the average color for L8/9 dwarfs (0.54, rms = 0.08 mag; Faherty et al. 2013). The observed $J - K_s$ and $W1 - W2$ colors for $<10^8$ yr-old, low surface gravity L dwarfs are systematically redder than those of older field L dwarfs (e.g. Cruz et al. 2009; Gizis et al. 2012; Faherty et al. 2013), hence there is no supporting evidence from the photometry to suggest that the binary could be as young as the Argus group.

⁷ Available upon request.

⁸ From van Leeuwen (2007).

4. COMMENTS ON NOMENCLATURE

The name WISE J104915.57-531906.1 obviously follows IAU convention (i.e. it is useful, conveys the position of the object in WISE images at epoch 2010, and "J" designates the equinox J2000 for the equatorial coordinate system), but it is rather unglamorous and lengthy for what is clearly a "special" pair of celestial objects that will be heavily studied in the future. Given how important this system will become given its provisional status as the nearest known system of substellar objects and the third nearest "star system" (and I use the term "star" in the general sense in that the pair is self-luminous, but the objects are not "stars" in the sense that they are hydrogen burning), a shorter name is warranted. "Phone number" names (e.g. WISE J104915.57-531906.1 or the shortened WISE J1049-5319 or even WISE 1049-5319) are fine for otherwise anonymous stars and galaxies, but this pair of objects is special, and it seems silly to call this object by a 24-character name (space included). Shortening the WISE name to shorter versions (e.g. "WISE J1049", "WISE 1049", "WISE 1049-5319", "WISE 1049-53") may lead to confusion if other interesting WISE-discovered objects are discovered in its vicinity (something that occurred with shorter names used for

2MASS and SDSS objects).

Luhman has already published several new binary star discoveries which are compiled in the Washington Double Star (WDS)⁹ catalog with discovery identifier "LUH". The WDS was originally published by Mason et al. (2001), and is updated frequently¹⁰. 15 "LUH" binaries are listed in the latest version of WDS. B. Mason (private communication, 17 Mar 2013) has confirmed that WISE J104915.57-531906.1 will be added to the WDS with discoverer identification "LUH 16", i.e. "Luhman 16". Hence the components could be called "Luhman 16A" and "Luhman 16B". As there will likely be additional interesting nearby WISE objects found, an alternative idea is to conjoin the names of the discoverer with "WISE": i.e. "Luhman-WISE 1". Either would be much more memorable than WISE J104915.57-531906.1 and any shorthand variant (and confusion will be avoided should another interesting WISE object be found with similar RA).

I thank Brian Mason for comments on the WDS, and Valentin Ivanov, Julian Girard, David Frew, and Kevin Luhman for discussions.

⁹ <http://ad.usno.navy.mil/wds/>

¹⁰ The latest version of the WDS at the time of writing was

dated 10 Mar 2013 and contained 125,271 binaries.

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History:

23 March 2013: minor edits to abstract. Replaced all instances of the shortened name "WISE J104915.57-531906" with the correct full name "WISE J104915.57-531906.1".

TABLE 3
ADOPTED CONVERGENT POINT SOLUTIONS

(1) Group	(2) α_{cvp} deg	(3) δ_{cvp} deg	(4) S km s^{-1}	(5) Ref.	(6) v_{disp} km s^{-1}
β Pic group	87.9 ± 0.9	-30.5 ± 0.8	21.4 ± 0.2	EEM	1.5
AB Dor group	90.4 ± 1.6	-47.3 ± 1.3	32.0 ± 1.0	Barenfeld et al. (2013)	1.0
UMa cluster	300.9 ± 3.2	-31.0 ± 2.3	17.3 ± 0.6	Mamajek et al. (2010)	1.3
Car-Near group	100.6 ± 0.9	-4.9 ± 1.2	31.2 ± 1.2	EEM	1.3
Hyades cluster	97.3 ± 0.2	6.9 ± 0.2	46.4 ± 0.1	de Bruijne et al. (2001)	0.3
Tucana group	117.7 ± 2.5	-29.9 ± 2.7	23.7 ± 1.5	EEM	1.1
Argus group	91.9	-1.2	25.3	Malo et al. (2013)	1.3
Columba group	103.3	-29.9	25.2	Malo et al. (2013)	1.0
TW Hya group	101.5 ± 0.6	-29.4 ± 0.5	21.9 ± 0.2	Weinberger et al. (2013)	0.8
Coma Ber cluster	114.5 ± 1.8	-34.5 ± 1.4	6.0 ± 0.1	EEM	1
32 Ori group	92.2 ± 0.9	-30.9 ± 0.9	23.7 ± 0.4	EEM	1
η Cha cluster	89.9 ± 0.3	-37.6 ± 0.3	25.7 ± 0.2	Murphy et al. (2010)	1
Alessi 13 cluster	104.5 ± 2.7	-28.8 ± 2.2	24.8 ± 0.9	EEM	1

NOTE. — Convergent points α_{cvp} , δ_{cvp} and space velocities S were calculated using the *UVW* velocities from the papers listed. 1D velocity dispersions v_{disp} are from the cited references, except that I adopt fiducial values of $v_{disp} = 1 \text{ km s}^{-1}$ for the Coma Ber, η Cha, and Alessi 13 clusters, and 0.8 km s^{-1} for TW Hya group from Mamajek (2005). The exact choice of adopted 1D velocity dispersion has negligible impact on the calculations, and no impact on the conclusions for the binary being studied.

TABLE 4
CONVERGENT POINT CALCULATIONS FOR WISE J104915.57-531906

(1) Group	(2) μ_v mas yr^{-1}	(3) μ_τ mas yr^{-1}	(4) ϖ_{pred} mas	(5) v_{pec} km s^{-1}	(6) Member?
β Pic group	2683	-736	708 ± 52	-4.9	No
AB Dor group	2437	-1342	497 ± 23	-12.8	No
UMa cluster	-1858	-2071	-510 ± 42	19.2	No
Car-Near group	2709	630	440 ± 25	6.8	No
Hyades cluster	2660	815	278 ± 2	14.0	No
Tucana group	2734	513	856 ± 80	2.8	No
Argus group	2762	329	510 ± 25	3.1	No?
Columba group	2779	-130	700 ± 49	-0.9	No
TW Hya group	2776	-180	758 ± 31	-1.1	No
Coma Ber cluster	2657	-823	3022 ± 230	-1.3	No
32 Ori group	2716	-603	671 ± 28	-4.3	No
η Cha cluster	2611	-959	622 ± 25	-7.3	No
Alessi 13 cluster	2781	-34	713 ± 47	-0.2	No

NOTE. — μ_v is the proper motion projected towards the group's convergent point, and μ_τ is the perpendicular component. Uncertainties in both μ_v and μ_τ are 6 mas yr^{-1} , following Luhman (2013). ϖ_{pred} is the predicted cluster parallax in mas, and v_{pec} is the predicted peculiar velocity. Negative μ_v and ϖ_{pred} means that the star is moving in the opposite direction predicted for group members (hence, unphysically negative parallaxes!). Luhman (2013) calculated a trigonometric parallax of $496 \pm 37 \text{ mas}$.